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Subject: Bark Beetle Activity in Recreation Sites on the Williams RD, Kaibab NF

To: Acting District Ranger, Williams RD, Kaibab NF ATTN: Christine Frisbee

On September 3 and 4, 2003, I visited four campgrounds on the Williams RD, Kaibab NF, at the request of Robin Rose, Recreation Staff Officer, to evaluate the area for bark beetle activity and current stand conditions. My evaluation consisted of a thorough ground survey to identify currently infested trees within and adjacent to the recreation areas and to assess the general stand structure (tree size classes and density). On September 4<sup>th</sup>, I met with Robin, Mark Herron, and Deirdre McLaughlin at both Dogtown Lake and Whitehorse Lake Campgrounds to discuss different management strategies. I describe in this report what bark beetle activity was observed in these areas, summarize prevention and control alternatives, and make recommendations to minimize bark beetle impacts.

### **Bark Beetle Activity on the Kaibab NF**

Both aerial detection surveys and ground surveys conducted by Forest Health Protection (FHP) have found high levels of bark beetle-killed ponderosa pine on the Kaibab NF. Inspection of fading trees and collected specimens determined that several species of pine engraver beetles (*Ips pini*, *I. lecontei*, *I. calligraphus*) and western pine beetle (*Dendroctonus brevicomis*) are the primary cause of pine mortality. These bark beetles are widespread throughout the West and can occasionally reach outbreak proportions (Kegley, et al., 1997; DeMars and Roettgering, 1982). In 2002, most of the trees were initially attacked by *Ips* species and subsequently infested by western pine beetle. This allowed western pine beetle populations to increase dramatically. Starting in the summer of 2003, we have seen attacks on many large-diameter pines and pockets of second growth pine initiated by western pine beetle.

A detailed summary of the aerial detection survey results will be provided to the Forest at a later date; however, our preliminary analysis showed that ponderosa pine mortality occurred on more than 50,000 acres in late 2002 through mid-summer 2003. This pine mortality is not unique to the Kaibab NF. High levels of both ponderosa and pinyon pine mortality have been documented across the state and throughout the Southwest during 2002 and 2003. Within many of these areas, ponderosa pine mortality is already greater than 25% for a given stand and as high as 90% in others. The vast majority of this pine mortality is related to the ongoing drought that the Southwest Region has been experiencing since 1996. If beetle populations continue to increase at the rate they have over the past few years, we can expect to see even greater levels of mortality throughout much of the forest.

### **Bark Beetle Activity in Developed Recreation Sites on the Williams RD**

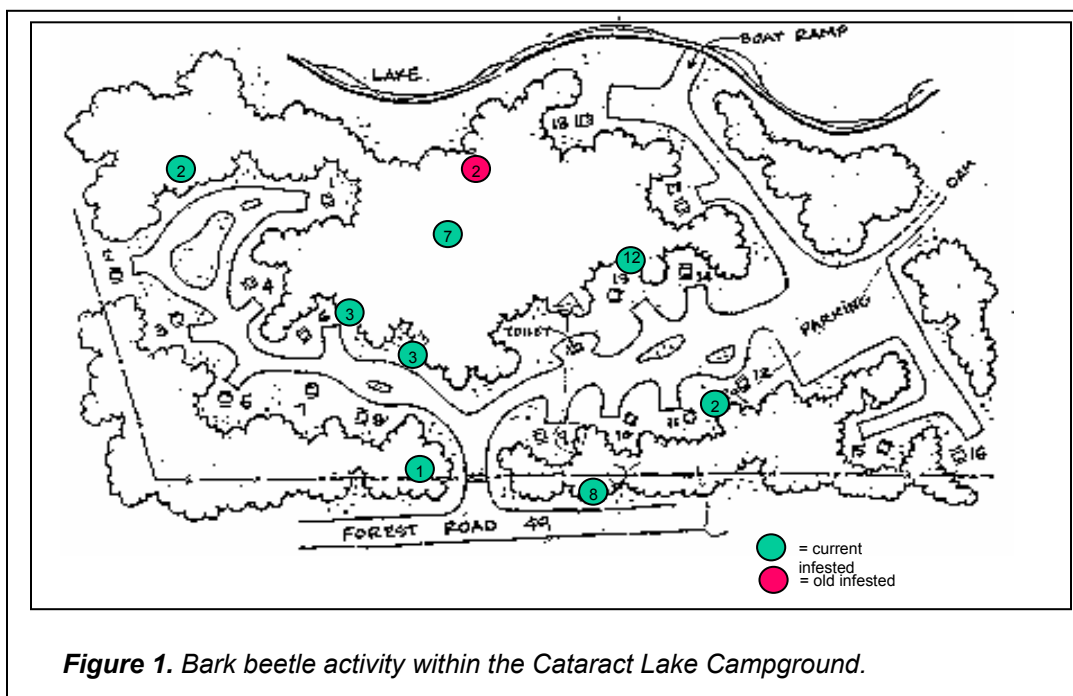
Trees growing in developed recreation sites are often stressed due to repeated damage caused by campers and soil compaction caused by roads and large vehicles parked off-road. During periods of drought or below-average precipitation such as has been occurring over the last few



years, these trees can become particularly stressed. This is further exacerbated by the relatively high density of ponderosa pine growing in some areas of the campgrounds. When trees are growing at high densities, there is more inter-tree competition for resources such as light, water, and nutrients (Kolb, et al., 1998). The combined effect of these factors is to lower the trees' production of defensive compounds and, consequently, increase susceptibility to bark beetle attack. Bark beetles may also prefer these dense stands, compared with more open stands, due to microclimate differences (Amman and Logan, 1998). This combination of factors increasing tree susceptibility seems to be what is occurring within the recreation sites on the Williams RD.

#### Cataract Lake Campground

Thirty-eight infested trees were identified throughout the campground (**Figure 1**). Most of the attacks were on relatively small-diameter ponderosa pine (i.e., less than 10 inches dbh) by *Ips pini* and western pine beetle (**Figure 2**). The exception being a few larger diameter trees that were attacked near the power lines running through the northeast section of the campground. Both infested trees and uninfested ponderosa pine next to the power lines have been marked for cutting by APS. Additional infested trees were observed across Cataract Lake and elsewhere in the vicinity. The stand structure throughout the campground is patchy and uneven-aged, with some areas having clumps of dense, small-diameter pine and other areas with well-spaced larger diameter trees.



**Figure 1.** Bark beetle activity within the Cataract Lake Campground.



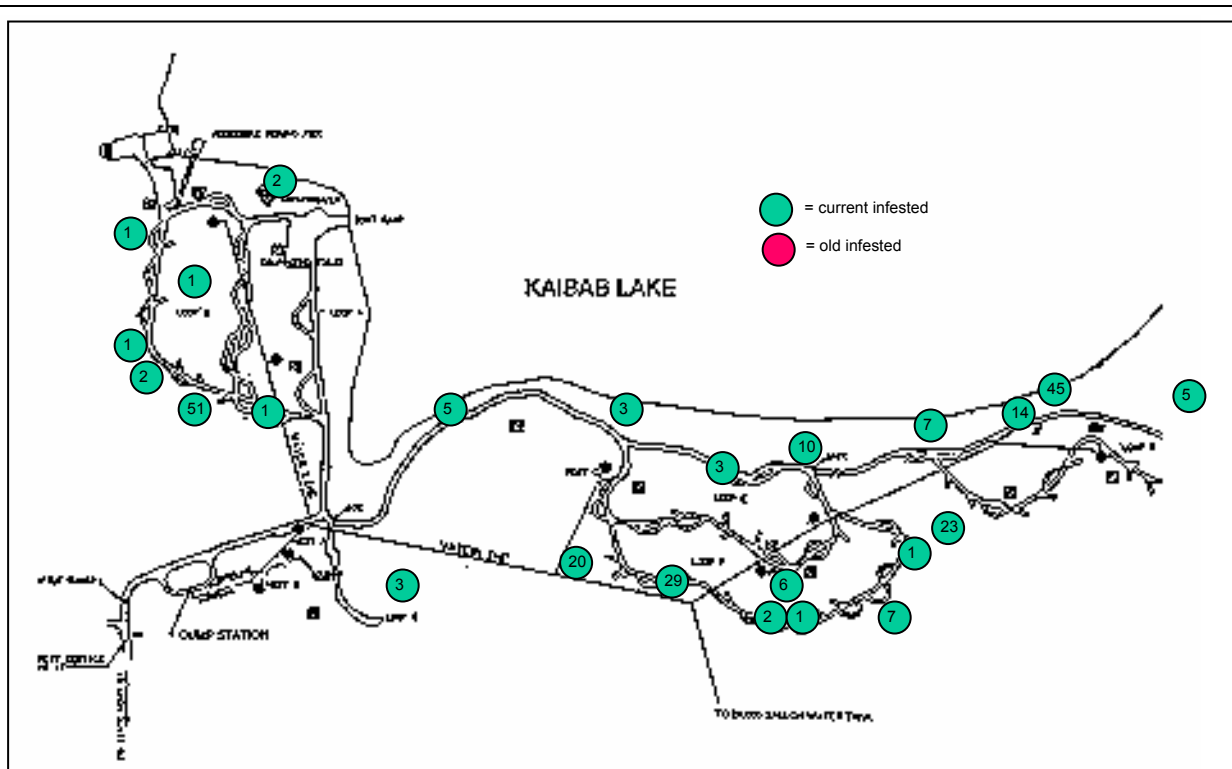
**Figure 2.** Bark beetle-infested ponderosa pine at Cataract Lake Campground.



**Figure 3.** Bark beetle-infested ponderosa pine at Kaibab Lake Campground.

### Kaibab Lake Campground

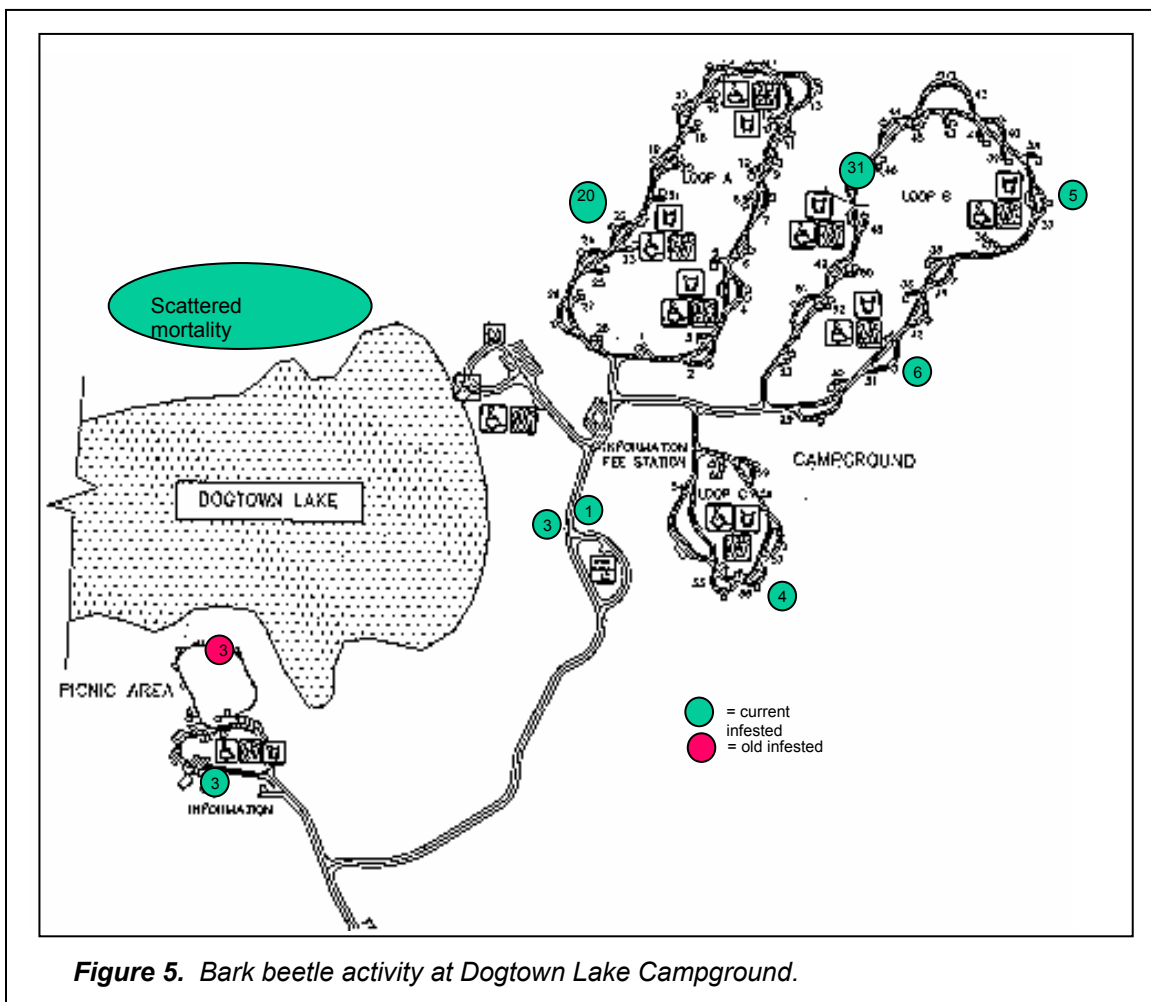
More than 200 infested ponderosa pines were identified within the immediate campground area (**Figures 3, 4**). Additional infested trees were observed across the lake and elsewhere in the vicinity. *Ips* beetles and western pine beetle attacked all age classes of ponderosa pine. The stand structure throughout the campground is patchy and uneven-aged, with some areas having clumps of dense pine and other areas with well-spaced diameter trees.



**Figure 4.** Bark beetle activity at Kaibab Lake Campground.

### Dogtown Lake Campground

Approximately 70 infested ponderosa pine trees were identified within the immediate campground area (**Figure 5**). Additional infested trees were observed across the lake and elsewhere in the vicinity. *Ips* beetles and western pine beetle attacked all age classes of ponderosa pine. In general, the stand structure throughout the campground is more even-aged than the other campgrounds visited, with most areas having relatively dense stands of ponderosa pine. This campground is undergoing a major restoration with road realignment, new toilets, etc. Several moderately sized ponderosa pine are being felled in the realignment process. Logs are being removed from the site and limbs/tops will be burned this winter. I observed *Ips* beetles already colonizing the recently created slash.



**Figure 5.** Bark beetle activity at Dogtown Lake Campground.

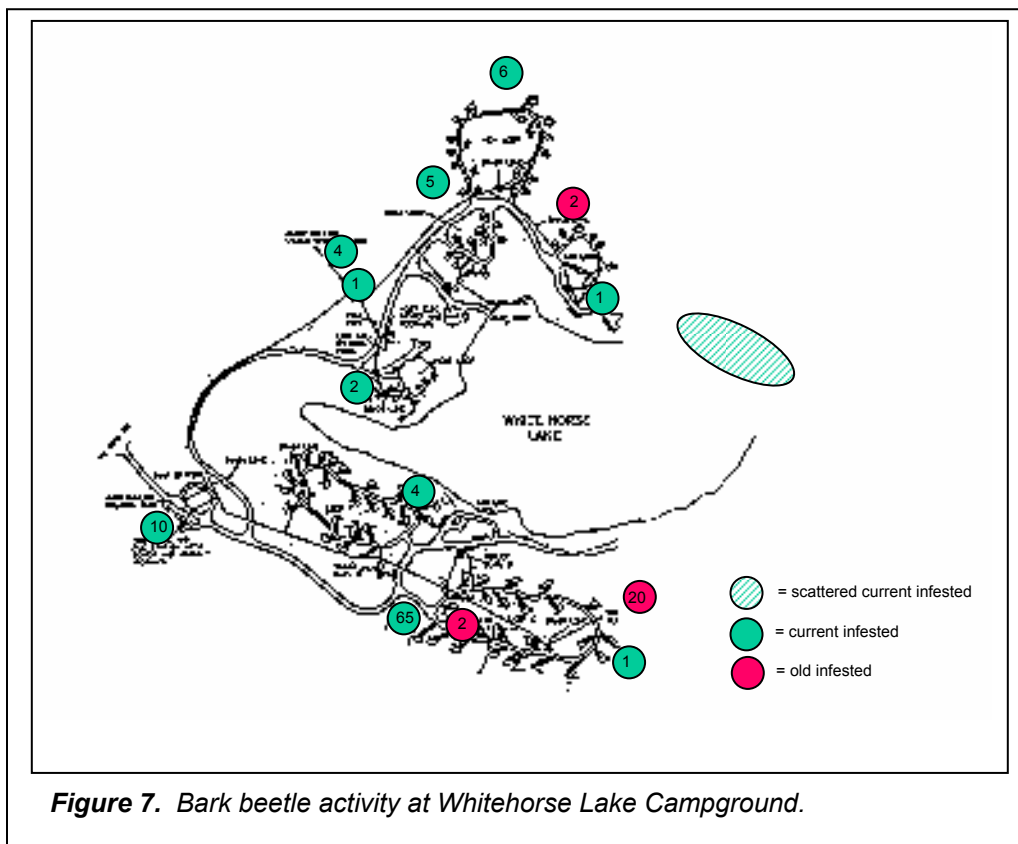
### Whitehorse Lake Campground

More than 90 infested ponderosa pines were identified within the immediate campground area (**Figures 6, 7**). Most of these trees were contained within a single group of infested trees. Additional infested trees were observed across the lake and elsewhere in the vicinity. *Ips* beetles and western pine beetle attacked all age classes of ponderosa pine. The stand structure throughout the campground is patchy and uneven-aged, with some areas having clumps of dense, small diameter pine and other areas comprised of well-spaced larger diameter trees.

We also visited three private “recreation” cabins near Whitehorse Lake that are under special use permit. In general, there was not a high amount of bark beetle activity in this area other than a small pocket of mortality behind the “Hunter” cabin. The forest stand in this area is relatively dense, and many of the larger diameter trees are infested with dwarf mistletoe.



**Figure 6.** Bark beetle-infested ponderosa pine at Whitehorse Campground.



**Figure 7.** Bark beetle activity at Whitehorse Lake Campground.

## Prevention and Control Alternatives for Bark Beetles

Management of bark beetle populations falls under two categories: direct action against the beetles themselves (control) or indirect action that addresses the general stand conditions (prevention). Direct action deals with the symptoms - too many beetles in one place at one time - and is aimed at directly reducing the number of beetles present. Indirect action focuses on the cause of the problem, which relates to tree health, and the optimal stand conditions for beetle buildup and outbreak. The only effective long-term strategy to minimize beetle-caused mortality is promoting and maintaining healthy forest conditions through silvicultural means over large areas, proper management of slash, and constant monitoring for areas of beetle population increases. The following are management alternatives available for consideration:

1. **No action.** Accept bark beetle-caused tree mortality and the impacts associated with it. The future extent of the damage to the stands in this area and surrounding areas is difficult to estimate, but there will be changes in the forest and recreation sites caused by beetles. If stand and weather conditions remain optimal for beetle outbreaks, the impacts can be expected to increase over the next several years.

Where to use: Use where other alternatives are not desired, cannot be used, or are not feasible.

*Advantages:* There is no mechanical site disturbance. There will be an increase in the amount of light getting to the forest floor, so that understory species and regeneration may be enhanced. Habitat for some wildlife species may be enhanced by decreasing crown closure and creation of standing dead trees.

*Disadvantages:* This alternative allows beetle populations to increase and spread to other trees and surrounding areas. Fire hazards can also increase with greater levels of dead material, including dry needles. Visual and recreation values can be negatively affected. The loss of overstory tree cover can have a negative effect for some wildlife species. Regeneration can be impeded as dead trees fall and cover or shade the forest floor. Watershed impacts are possible on steeper slopes due to the decrease in tree canopy interception and root activity.

2. **Silvicultural treatments.** These are forest management actions that increase tree vigor and reduce stand susceptibility to beetle attack through reducing basal area or controlling other stand conditions. They are preventive treatments that should be completed prior to stands experiencing beetle outbreaks if possible. No stand hazard rating models have been developed for pine engraver beetles species attacking ponderosa pine, primarily because beetle populations are driven by drought and factors leading to large amounts of slash. Stand hazard rating for *Dendroctonus* bark beetles of ponderosa pine involves measures of tree size, stand or group density (basal area), and the percent of host trees within the stand. In general, ponderosa pine stands that have an average DBH greater than 12 inches and a basal area greater than 120 ft<sup>2</sup>/acre are considered at high risk to bark beetle attack (Chojnacky, et al., 2000; Negrón, et al., 2000). In addition, it has been indicated that in California, the thinning of dense, 70- to 80-year-old sawtimber stands is an effective silvicultural method for managers of both small and large holdings for prevention of western pine beetle attacks (DeMars and Roettgering, 1982). Reducing stand stocking to 55 to 70 percent of the basal

area needed for full site utilization will relieve the competitive stress among the remaining trees, improve their vigor, and make them less prone to successful western pine beetle attack.

On the Kaibab NF, stands that have less than 80 square feet of basal area per acre should be considered the lowest risk. It is important to keep in mind that while thinning your trees is an excellent long-term preventive measure, thinning alone may not be enough to protect trees from bark beetles. In order for the leave trees to benefit from thinning, they need water before beetles start an attack. All the fresh cut “slash” (cut tree trunks, limbs, and trimming debris) must be treated properly to keep beetles from breeding in it and moving into adjacent residual green trees.

Where to use: This is a preventive strategy and should be used regularly when planning tree removal, urban interface treatments, and maintaining recreation sites. Thinning or other silvicultural treatments should not be considered a stand-alone tool in areas currently experiencing a beetle outbreak.

*Advantages:* Controlling stand conditions can reduce overall stand susceptibility to beetle infestation. It does not guarantee that beetle-caused mortality will be eliminated; it creates conditions that are less likely to experience a beetle outbreak. It can maximize the economic return from tree removal, as cutting is done prior to mortality taking place. Although the forest will experience mortality through time, treating stands through silvicultural prescriptions allows the decisions on what the forest will look like in the future through the types of treatments implemented. If not, the beetles will decide what the forest will look like in the future through their actions; and this may be considerably different from management goals or not within limits of change acceptable to the public.

*Disadvantages:* This action is not suitable for areas where tree removal or treatment of slash is not feasible. There are site disturbances associated with treatments or tree removal while the cutting is being done.

3. **Sanitation/salvage removal.** Sanitation removal involves removing currently infested pines prior to the beetle maturation and emergence. It requires the removal of green trees that have live brood in them. Trees removed are treated; either moved to at least one mile from the nearest live host type or processed at the mill, prior to beetle emergence. Salvage removal involves the taking away of beetle-killed trees that do not have live beetles in them. These trees have already changed color; all their needles are either red or gone.

Where to use: In stands susceptible to bark beetles that are currently under attack and where it is desirable to reduce beetle populations and recover resource value. Also appropriate where beetle populations threaten currently uninfested nearby stands, adjacent private lands, and recreation sites.

*Advantages:* Bark beetle populations can be reduced in localized areas and in individual stands by removing most of the currently infested trees. This can provide some protection to surrounding uninfested trees and stands by removing a large source of attacking beetles. Resource values are recovered that would otherwise be lost or degraded. Fuel loading and fire hazard can be reduced by removal of much of the dead needles and timber. Regeneration can be enhanced through overstory removal and site disturbance. Potential future hazard trees are also removed from the site.

*Disadvantages:* This alternative has a short implementation time. Areas must be marked and cut prior to beetle flight; i.e., before the beginning of April or within four weeks of the initial attack. Sanitation removal is only effective at suppressing beetles at the stand level; it is not typically effective on a landscape scale. Site disturbance that accompanies tree removal occurs.

4. **Infested tree treatment.** Cut and individually treat infested trees prior to beetle emergence. The action should kill most or all of the beetles within the cut trees. Examples of treatments include: cut and burn on site, cut and bury at least 6 inches deep on site, cut and chip, or cut and debark. When burning infested trees or slash, the material does not need to be entirely consumed; only the outer bark and cambium needs to be charred significantly enough to kill the brood. The use of a terra torch has been proven effective at treating infested green slash piles in Arizona.

Where to use: This is most appropriate for treating small spots in areas where high value resources are nearby.

*Advantages:* Small spot beetle populations can be reduced or eliminated from the treated area. This can provide some relief to surrounding uninfested stands and trees. The site disturbance is less than in conventional tree removal operations. Regeneration can be enhanced through the removal of overstory trees. Fire hazard and hazard trees can be reduced.

*Disadvantages:* The implementation time for this alternative is short. Treatments must be done after new infested trees are located and prior to beetle flight. This treatment only reduces beetle pressure in a small area; it is not effective on a landscape scale. This treatment does not address stand conditions that led to beetle buildup in the first place.

5. **Protection of high value trees.** Valuable trees in recreation sites or near administrative structures may be sprayed with carbaryl (Sevin products) to prevent successful attack (Parker, 1991). Both the trunk and large branches (>4" diameter) should be sprayed. Because pine engraver beetles generally initiate attacks near the top of the bole, it is important that the spray reach this area. Attacking beetles die as they attempt to chew through the bark. Preventive sprays are not recommended for trees already attacked. Systemic injections of insecticides do not work, either as a preventive or a direct control of bark beetles on pine (Haverty, et al., 1996).

Where to use: On trees around administrative sites, in campgrounds, or other high-value areas. Trees must be of significantly high value and be under heavy beetle pressure to justify treatment costs.

*Advantages:* This action can be effective at protecting individual trees from becoming infested, if applied properly.

*Disadvantages:* Insecticide application does not effectively reduce beetle populations or address the cause of the outbreak. It does not guarantee protection; application must be thorough for it to be effective. Many people have concerns regarding environmental contamination when using pesticides. It is extremely expensive on a large scale and, therefore, is only appropriate for high-value trees within a small area, such as in

campgrounds and other administrative sites. Analysis of environmental effects is more involved before use on Federal lands is permitted, and application by a licensed pesticide applicator is required.

## Recommendations

Because the current beetle infestation is occurring on the landscape scale and is largely a result of the ongoing drought, it is essentially impossible to control the beetle population as a whole through management actions. Therefore, control actions should be limited to the most critical, high-value areas that have adequate accessibility.

Based on the current weather and stand conditions, setting, and large population of bark beetles within the immediate area, trees within the campgrounds are highly susceptible to beetle attack. Therefore, a combination of removal of infested trees, thinning, and potentially the application of preventive insecticide sprays is recommended for the sites.

Strategies for applying the preventive sprays have been developed by other Forests in Arizona and the West. It has been suggested that 5 to 10 trees per campsite or picnic area are needed to provide adequate shade and screening. This general guide can be used for determining the number of trees to be sprayed within a campground or day-use area. Candidate trees include those that have good structural form, are 12 inches and larger, and are in close proximity to tent pads, cooking areas and picnic tables. No spray buffer zones around standing or moving water are required; therefore, trees in some of these campgrounds cannot be sprayed. If the District is considering spraying, further guidelines can be provided.

It is recommended that the infested trees be removed this fall/winter or early spring (i.e., before April 1<sup>st</sup>) before the brood completes their development and adult beetles emerge. If infested trees are cut, they must either be removed from the site, or, if left onsite, the bark should be stripped off to kill the developing beetle brood or the trees chipped.

A treatment of thinning from below to a target basal area of 80 ft.<sup>2</sup> per acre or lower will help to reduce the overall susceptibility of the stand in the long term. Thinning from below has been experimentally demonstrated to increase the resistance level of the residual mature pine overstory (Feeney, et al., 1998). As mentioned above, thinning slash must be removed from the site or treated in such a way as to prevent its becoming brood material for *Ips* beetles. This is extremely important to consider in the coming year while bark beetle populations are high. Removal of thinning slash from the recreation areas is the best option. Another method of treating fresh slash is to chip all material greater than 4 inches in diameter and then haul the chips out of the ponderosa pine type or to an open area. Slash debris less than 4 inches diameter can be piled and burned in the winter or as conditions allow.

Although no experimental studies have been conducted to examine the relationship between chipping and bark beetle attraction, we do know that bark beetles are attracted to tree compounds such as terpenes. Fresh-cut trees and chips release high quantities of terpene volatiles that can attract bark beetles. To minimize the potential of chips attracting bark beetles, chips should be spread out as much as possible in open areas rather than in shaded areas or removed from the site. Try to prevent piling the chips at the bases of pine trees. If the chips are spread out in a thin layer and out in the sun, they will dry quickly and, therefore, stop emitting terpene volatiles. Chipping in the fall probably has less risk than chipping at other times of the year.

Because of the extent of work that needs to be done, the completion of all recommended treatments may not be feasible in the coming year. If requested, I can work with your staff to help develop priority strategies.

Prevention and Suppression funds may be available for FY2004 from Forest Health Protection to implement projects related to bark beetle activity in these recreation sites. Requests for these funds should be submitted no later than October 17, 2003.

If you have any questions regarding my assessment of current bark beetle activities within the area, its potential effect on residual standing trees, or my recommendations, please let me know.

/s/ Joel D. Mcmillin  
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Arizona Zone

Enclosure

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